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COST ESTIMATING

**The Use of Inflation Indexes in the Department of Defense**

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**Institute for Defense Analyses**

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## Preface & Acknowledgements

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Welcome to our Tenth Annual Acquisition Research Symposium! We regret that this year it will be a “paper only” event. The double whammy of sequestration and a continuing resolution, with the attendant restrictions on travel and conferences, created too much uncertainty to properly stage the event. We will miss the dialogue with our acquisition colleagues and the opportunity for all our researchers to present their work. However, we intend to simulate the symposium as best we can, and these *Proceedings* present an opportunity for the papers to be published just as if they had been delivered. In any case, we will have a rich store of papers to draw from for next year’s event scheduled for May 14–15, 2014!

Despite these temporary setbacks, our Acquisition Research Program (ARP) here at the Naval Postgraduate School (NPS) continues at a normal pace. Since the ARP’s founding in 2003, over 1,200 original research reports have been added to the acquisition body of knowledge. We continue to add to that library, located online at [www.acquisitionresearch.net](http://www.acquisitionresearch.net), at a rate of roughly 140 reports per year. This activity has engaged researchers at over 70 universities and other institutions, greatly enhancing the diversity of thought brought to bear on the business activities of the DoD.

We generate this level of activity in three ways. First, we solicit research topics from academia and other institutions through an annual Broad Agency Announcement, sponsored by the USD(AT&L). Second, we issue an annual internal call for proposals to seek NPS faculty research supporting the interests of our program sponsors. Finally, we serve as a “broker” to market specific research topics identified by our sponsors to NPS graduate students. This three-pronged approach provides for a rich and broad diversity of scholarly rigor mixed with a good blend of practitioner experience in the field of acquisition. We are grateful to those of you who have contributed to our research program in the past and encourage your future participation.

Unfortunately, what will be missing this year is the active participation and networking that has been the hallmark of previous symposia. By purposely limiting attendance to 350 people, we encourage just that. This forum remains unique in its effort to bring scholars and practitioners together around acquisition research that is both relevant in application and rigorous in method. It provides the opportunity to interact with many top DoD acquisition officials and acquisition researchers. We encourage dialogue both in the formal panel sessions and in the many opportunities we make available at meals, breaks, and the day-ending socials. Many of our researchers use these occasions to establish new teaming arrangements for future research work. Despite the fact that we will not be gathered together to reap the above-listed benefits, the ARP will endeavor to stimulate this dialogue through various means throughout the year as we interact with our researchers and DoD officials.

Affordability remains a major focus in the DoD acquisition world and will no doubt get even more attention as the sequestration outcomes unfold. It is a central tenet of the DoD’s Better Buying Power initiatives, which continue to evolve as the DoD finds which of them work and which do not. This suggests that research with a focus on affordability will be of great interest to the DoD leadership in the year to come. Whether you’re a practitioner or scholar, we invite you to participate in that research.

We gratefully acknowledge the ongoing support and leadership of our sponsors, whose foresight and vision have assured the continuing success of the ARP:



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# Cost Estimating

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# The Use of Inflation Indexes in the Department of Defense

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## Abstract

The 2009 Weapon System Acquisition Reform Act (WSARA) requires the DoD's Office of Cost Assessment and Program Evaluation (CAPE) to "periodically assess and update the cost (or inflation) indexes used by the Department to ensure that such indexes have a sound basis and meet the Department's needs for realistic cost estimation." The objective of this paper is to provide CAPE with a factual and analytical basis for responding to this provision of WSARA.

The paper starts with a discussion of the rationale for using inflation indexes in general, in the government as a whole, and in the DoD. It then identifies the regulatory and statutory provisions that support the issuance of inflation guidance by the Under Secretary of Defense



(Comptroller; USD[C]). Next, it describes how this guidance is applied by describing the key features of the processes used in the Office of the Secretary of Defense (OSD) and the Services to adjust for inflation in estimating the costs of and budgeting for major systems. It evaluates the appropriateness of using the inflation indices provided by the USD(C). Finally, it compares the Comptroller's rates with some alternatives and considers whether modifications to current practices might better meet the DoD's needs for realistic cost estimation.

## Introduction

The 2009 Weapon Systems Acquisition Reform Act (WSARA) requires the DoD, Office of Cost Assessment and Program Evaluation (CAPE) to "periodically assess and update the cost (or inflation) indexes used by the Department to ensure that such indexes have a sound basis and meet the Department's needs for realistic cost estimation." The objective of this paper is to provide CAPE with a factual and analytical basis for responding to this provision of WSARA. Because WSARA is concerned with the cost of major systems, much of our attention is given to the treatment of inflation by Major Defense Acquisition Programs (MDAPs).

In the next section, we present a discussion of the general rationale for inflation and price indexes, whether applied to the economy as a whole, to the government, or to the DoD. In the section The Derivation of Inflation Indexes for Use by the DoD, we describe how DoD price indexes are developed. We address (a) the regulatory and statutory provisions that govern the issuance of inflation guidance by the Under Secretary of Defense, Comptroller (USD[C]), and (b) how these provisions are applied by describing the key features of the processes used in the Office of the Secretary of Defense (OSD) and in the Services to produce inflation guidance.

In the next two sections, we turn to how the DoD uses the deflators and other considerations in budgeting and in cost analyses related to procurement. We then discuss the current practices by the DoD in general and by the Services. In the section Analysis of Alternative Deflators for MDAPs, we compare the USD(C)'s price index for procurement with alternatives, principally the national defense indexes published by the Bureau of Economic Analysis (BEA), and defense-related relevant producer price indexes published by the Bureau of Labor Statistics (BLS). The purpose of these comparisons is to explore the possibility that modifications to current practices might better meet the DoD's needs for realistic cost estimation.

We next assess current DoD practices for accounting for inflation; and in the final section, we present concluding observations and recommendations.

We are careful, in discussing price indexes, to differentiate between those that cover the entire economy and those that cover specific classes of goods and services. The former we generally refer to as inflation indexes and the latter as price indexes or escalation indexes.

## The General Rationale for Inflation Indexes

The purpose of inflation and other price indexes is to relate changes in the quantity of resources bought or sold to the amount of money spent on them (Allen, 1935, p. 58). Price indexes identify and isolate the effect of price changes. Removing the effect of price changes leaves information on quantity, or real, changes. Indexes permit us to answer questions like the following<sup>1</sup>:

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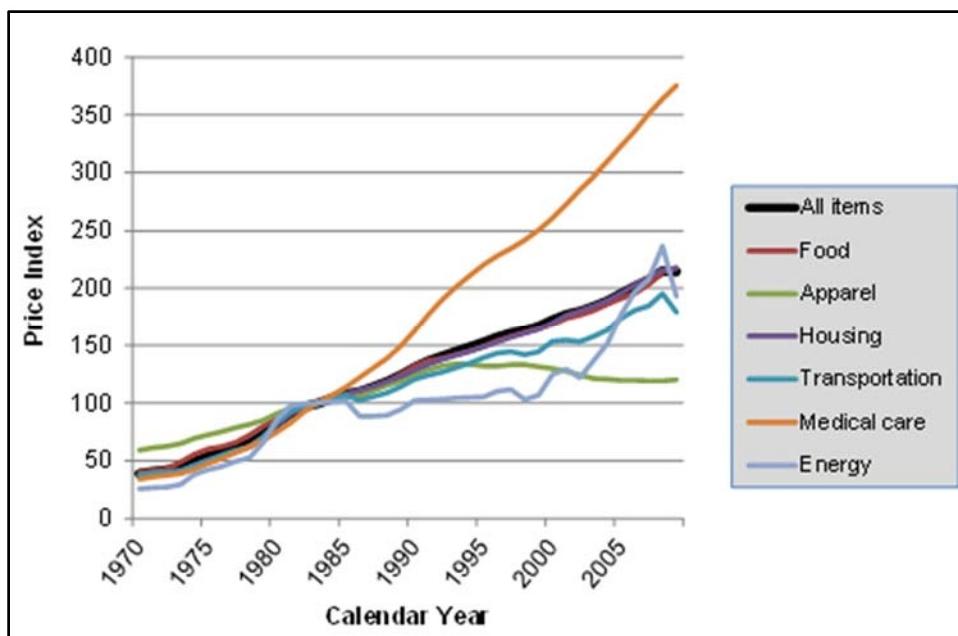
<sup>1</sup> Conceptually, a price index measures the ratio of expenditures under two alternative price systems that provide quantities of goods and services of the same value.



- What has been the change in the real size of the economy over time?
- What effect have changes in the DoD budget had on the resources taken from the economy and the resources available to the DoD?
- How much real cost growth has there been in particular DoD procurement programs?

Price indexes are meant to capture changes in the price of a particular level of capability. They should not capture price changes that are due to changes in the quality of products. As an example, the availability of much better computers at only slightly higher prices means society has gotten richer in real terms. Allowing price indexes to rise with price increases associated with quality improvements would make this appear not to be the case, so price indexes should *not* reflect the price of quality improvements. In other words, the portion of price changes that reflect quality improvements should be subtracted from price indexes. (We will later see that BEA and BLS indexes follow this procedure.)

Price indexes can be developed for different classes of goods and services: the economy as a whole; all DoD spending; DoD procurement; specific types of DoD goods such as aircraft, ships, and computers; and the input prices facing firms that produce things for the DoD. Price indexes for different kinds of goods and services can vary substantially over time. Figure 1 shows how indexes for commercial goods and services have varied with the type of good and over time during the last 40 years. Some types of goods and services have moved along with the overall consumer price index (CPI). For example, the price of apparel has risen far more slowly, and the price of medical care has climbed at nearly double the overall rate since 1970.



**Figure 1. Consumer Prices for Selected Classes of Major Expenditures**  
(Administration of Barack Obama, n.d., Table B-60)

The fact that one index has not fit all cases of commercial goods suggests that budgeting defense goods for the future should also distinguish between types of goods. In an International Monetary Fund paper, Premchand (1983) put it succinctly: "Every budget is formulated, either explicitly or implicitly, on a price basis. As prices rise and become



relatively unpredictable, the problems of budgeting are felt more keenly" (p. 242). Using different price indexes for different goods can help to ameliorate these problems. The BEA, which produces the U.S. National Income and Product Accounts, notes that the use of a price index is appropriate if its definition and coverage closely match the category of product to which it is applied (BEA, 2009).

Different organizations take different approaches in accounting for inflation in budgeting. Organizations such as the Treasury and the Office of Management and Budget (OMB) that are involved in financing aggregate government expenditure focus on broad issues, such as the balance between the public and private sectors, and particularly on the value to the private sector of resources taken for public purposes. These offices commonly analyze these issues using the GDP deflator, an index based on the price of the market basket of all goods and services provided to final users by the entire U.S. economy.<sup>2</sup> By comparison, organizations such as the DoD Comptroller's office that are responsible for the budgets of particular government agencies frequently use indexes that reflect the prices of the specific resources their agencies buy to support their activities (Premchand, 1983, pp. 246–247). A possible compromise would use specific indexes to develop budgetary requirements and a broad index to reflect the constant-dollar burden implied for the economy as a whole.

### **The Derivation of Inflation Indexes for Use by the DoD**

This section has three objectives:

- to identify the regulatory and statutory provisions that authorize and prescribe the issuance and use of guidance related to inflation in the DoD;
- to describe the flow of information for developing the economic assumptions, including those for inflation, used in generating the President's Budget; and
- to describe the five price indexes constructed by OMB and how they are used to develop the Comptroller's appropriation-specific deflators.

### ***Regulatory and Statutory Basis***

The statutory requirement for all government budgeting is contained in Title 31 of the *United States Code* (U.S.C.), § 1104, entitled "Money and Finance." This title directs the President to create an annual budget, delegating administrative authority to the OMB.<sup>3</sup> The OMB requires every agency to prepare an annual budget for its spending that expresses the administration's most recent policy objectives (31 U.S.C. § 1109).<sup>4</sup> OMB forms these inputs into a total annual "policy" budget called the President's Budget.

The President's Budget consists of spending for two types of programs:

- discretionary programs, such as DoD procurement line items, which are funded at a level decided by Congress every year; and

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<sup>2</sup> GDP is the sum of consumption, investment, government spending, and exports minus imports.

<sup>3</sup> 31 U.S.C. § 1104 resulted from the Budget and Accounting Act of 1921. Administrative responsibility initially existed within the Bureau of the Budget, with the OMB tasked through Executive Order in 1970.

<sup>4</sup> The OMB also prepares a "baseline," or "current services" budget, that assumes that current-year programs will extend into the budget year and out-years, and updates their costs using the most recent economic assumptions.



- mandatory programs, such as Social Security and Medicare, which are passed as permanent law by congressional authorization, written into the U.S.C, and funded by annual appropriation as directed by the permanent law.

This paper concerns inflation for only the discretionary programs. The following paragraphs describe the general guidance contained in OMB Circulars A-11 and A-94 and the specific guidance to DoD Components in the Financial Management Regulation (FMR), issued by the OUSD(C), for meeting the OMB guidance.

OMB Circular No. A-11 (2009) sets policy for how agencies are to treat inflation in their budget requests submitted for executive review. The relevant excerpt from Section 31 (Paragraph 31.1(c)) of the circular provided below states that agencies must ensure that their inputs to the discretionary part of their budgets must be consistent with the OMB's economic assumptions, including those relating to inflation.

**(c) *What economic assumptions should I use when I develop estimates?***

All budget materials, including those for the outyear policy and baseline estimates, must be consistent with the economic assumptions provided by OMB. The specific guidance below applies to outyear policy estimates.

OMB policy permits **consideration** of price changes for goods and services as a factor in developing estimates. However, this does not mean that you should automatically include an allowance for the full rate of anticipated inflation in your request. ....

For **discretionary programs**, you may include an allowance for the full rate of anticipated inflation, an allowance for less than the full rate, or even no allowance for inflation. In many cases, you must make trade-offs between budgeting increases for inflation versus other increases for programmatic purposes.<sup>5</sup>

OMB Circular No. A-94 (1992) provides agencies with guidance for cost-benefit analyses. It recommends using the gross domestic product (GDP) deflator for the overall inflation rate—the general increase in prices of goods and services—but permits using sector-specific indexes that differ from the general inflation rate “where there is a reasonable basis for estimating such changes.” Projects with a budget horizon longer than six years (the Future Years Defense Program (FYDP) years in the case of the DoD) are advised to use the final year’s rate in perpetuity.

The Financial Management Regulation (FMR) 7000 14-R (DoD, n.d.) provides inconsistent guidance concerning price indexes in two paragraphs of Volume 2A, Chapter 1, Section 010303. Paragraph B.1 states that DoD budget estimates should “reflect the most likely or expected full costs.” Paragraph B.2, however, mandates that “price level changes will be based on data provided by OUSD (Comptroller),” and that the Comptroller’s appropriation-specific price indexes should be used to “determine the amount of price escalation for a procurement line item, major RDT&E system, or construction item over a given time period.” This guidance is being revised to make it clear that the most likely or expected full costs in then-year dollars should be used in budget preparation—even if this implies price increases different from those implied by Comptroller’s indexes—and that Comptroller indexes must be used to convert then-year dollar values to constant-dollar values.

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<sup>5</sup> This section is titled “Compliance With Administration Policies and Other General Requirements” and is the only inflation guidance that appears in the 1,000-page document.



Paragraph B.2 seems to direct the use of the Comptroller's indexes as the only acceptable value for calculating price escalation for specific programs, while the "most likely or expected full costs" of paragraph B.1 are presumably those for the specific items being purchased (DoD, n.d.). This appears inconsistent because the Comptroller's indexes are not at all specific to the particular goods being purchased.

### ***Development of Economic Assumptions***

Each fall, senior officials and staff from the OMB, the Council of Economic Advisors, and the Department of the Treasury (collectively known as the "Troika") draw on administration policies and use various forecasting models to produce a 10-year forecast of key economic indicators, including inflation. These economic assumptions update previous assumptions to reflect recent data. They are used in forming budget outlay and revenue estimates and developing the annual President's Budget.

The OMB provides the economic assumptions regarding inflation<sup>6</sup> to the federal agencies each November as guidance. That guidance, and how the DoD Comptroller uses it to develop more detailed guidance for DoD Components, is discussed next.

### ***Derivation of Appropriation-Specific Price Indexes***

OMB guidance sent to the OUSD(C) covers the two prior years, the budget year, and four out-years for five categories of funding:

- Military pay, using the projected Employment Cost Index (ECI) for wages and salaries published by the BLS, of the Department of Labor, adjusted for administration policy recommendations as prescribed in Title 37 U.S.C. Section 1009
- Civilian pay, using the projected ECI less 0.5 percentage points, adjusted for administration policy recommendations, as prescribed in Title 5 U.S.C. Section 5303
- Fuel, using the projected Energy Information Administration Refiner Acquisition Cost; this is the oil refiners' average price for crude oil
- Medical, using the projected BLS Consumer Price Index for All Urban Consumers (CPI-U) Medical price index
- Other purchases—all purchases other than the four categories just listed—using the projected values of BEA's GDP price index as determined by the Troika and provided to the Comptroller by the OMB

The OUSD(C) uses weighted averages of these five OMB indexes to construct the annual price indexes (often called deflators) for the DoD appropriation-level accounts shown in Table 1. The weights are based on how the spending for each account is distributed across the resources represented by the OMB indexes (military pay, civilian pay, etc.).

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<sup>6</sup> The Administration's economic assumptions include projections of consumer inflation measured by the urban Consumer Price Index, GDP (Current, Real, and the Price Index between them), Unemployment rate, 91-day Treasury Bill interest rate, and 10-year Treasury Bill interest rate. They are available in the OMB's "Supplemental Materials" (see OMB, n.d.).



**Table 1. Composition of Appropriation Level Inflation Deflators**  
 (Office of the Under Secretary of Defense, Comptroller [OUSD(C)], 2010)

Appropriation (FY 2010 Outlays)	MilPay	CivPay	Fuel	Medical	Other Purchases
Military Personnel (\$155.0B)	61%			8%	31%
O&M (\$279.7B)		30%	5%	12%	53%
Procurement (\$147.2B)					100%
RDT&E (\$79.3B)		11%	<1%		89%
Military Construction (\$23.8B)		5%			95%
Family Housing (\$3.3B)		4%	1%		95%

The OMB directs that, in deflating program spending for years beyond those for which indexes have been made available, program managers should extend the final year's inflation rate into the later years (OMB, 1992, Section 7.b.).

The table illustrates the process for the FY 2010 budget. For example, 30% of total DoD spending on operations and maintenance (O&M) was for civilian pay. The O&M index was therefore calculated as follows:

$$\begin{aligned} \text{O\&M index} &= (\text{CivPay index}) \times 0.30 + (\text{Fuel index}) \times 0.05 \\ &\quad + (\text{Medical index}) \times 0.12 + (\text{Other Purchases index}) \times 0.53 \end{aligned}$$

It is significant that while the first four OMB indexes characterize specific types of resources (civilian pay, etc.), the last one, "other purchases," does not. In fact, the OMB index for all other purchases is the GDP deflator, the single price index for all spending on U.S. goods and services. The GDP deflator is the main determinant of the amount of inflation allowed in the DoD budget. It is the sole determinant for procurement spending and is applied to fully 64% of total spending. (Weighting the "other purchases" percentages in the last column of Table 1 by the proportion of total outlays implied in the first column yields a weighted average of 64%).

The OUSD(C) deflators are issued to the DoD Components by guidance memo. The assistant secretary (financial management and comptroller) of each military department issues implementing guidance to its commands and components that is tailored to its department's administrative procedures. The components use the deflators and instructions contained in the DoD FMR to re-price the President's Budget through a resource management decision for submission to the OMB, and also to prepare detailed budget justification material for submission to the Congress.

#### **Current Practice for Incorporating Inflation Into Program Budgets and Cost Estimates for Major Defense Acquisition Programs**

The DoD buys millions of different products: food for Service mess halls, spare parts, construction material, medical supplies, medical equipment, construction equipment, and many others. In these instances, the DoD buys at prices generally available in the market to large buyers. Price indexes for these kinds of commodities are properly based on their output prices. Such indexes might often approximate a broad-based index like the GDP deflator.



In this paper, we do not focus on these kinds of purchases. We are interested specifically in MDAPs because they are the focus of WSARA. Contracting procedures require that the prices of major defense systems be based on the costs of the inputs to the systems: labor and materials. This is even true of fixed-price types of contracts. Firm-fixed-price contracts are based on the expected cost of inputs, while fixed-price with economic price adjustment contracts incorporate fluctuations in labor or material costs during the period of contract performance. It appears that the use of price indexes based on the relevant input prices is best for MDAPs.

In this section, we provide an overview of the treatment of inflation by MDAPs and then turn to the practices of the individual Services.

### ***General Considerations in Use of Inflation Indexes by Program Managers***

Program budgeters have to think about inflation for two reasons:

- In budgeting, they must estimate the future costs of their procurement programs in then-year dollars that are based on expected increases in prices.
- They must calculate real cost increases of systems being acquired in constant (inflation-corrected) dollars, also termed real cost growth. Such calculations are used to identify systems that are suffering from high levels of real cost growth, a focus of WSARA.

In addition, all parts of the DoD must use price indexes to translate budget submissions developed in then-year dollars to constant-dollar terms.

Regarding budgeting, for a program to be fully funded, money must be appropriated up front to cover all projected future then-year costs of the portion of the program authorized in a given year, such as a specified annual production lot. If planners underestimate the extent to which the cost of the authorized program will rise over time, due to either unanticipated general inflation or increases in the prices of inputs specific to the program, appropriations will fall short and an overrun will occur—an undesirable outcome. We noted earlier that guidance regarding the treatment of inflation in budgeting appears inconsistent, calling for the use of OUSD(C) deflators and also mandating use of “most likely or expected full costs.” As we shall see, some DoD organizations rely on the Comptroller’s projections of inflation for developing then-year budget estimates, while others do not.

Real cost growth is measured by the percentage increase in unit cost relative to a past baseline evaluated in baseline-year constant dollars. The baseline cost can be either the original program cost or a later estimate, depending on the program’s history. For procurement programs, the Nunn-McCurdy Amendment to the 1982 National Defense Authorization Act requires the DoD to identify for special attention those programs whose average unit cost growth has breached stated thresholds.

Selected Acquisition Reports (SARs) are used as the source of information concerning cost. The GDP deflator is always used to convert current-dollar costs to constant base-year dollars both for establishing the real cost baseline and for calculating real cost growth.

We now turn to the specifics of how various DoD organizations incorporate inflation into their program budget estimates.

### ***Practices of Individual Organizations***

In this section, we briefly describe the procedures various DoD organizations use in incorporating inflation into program procurement budgets. Information in this section is



based on discussions with staff in the organizations cited. Because not all relevant organizations have been contacted, this is not a complete survey.

### **Army**

The Army follows OSD budget guidance without exception in adjusting program costs and budgets for inflation.<sup>7</sup> The indexes the Army uses are stored together with the standard Navy and Marine Corps indexes on the Navy Center for Cost Analysis's (NCCA's; n.d.) website tool for calculating inflation factors.

### **Navy and Marine Corps**

**NAVSEA Projections of Shipbuilding Cost.** The Naval Sea Systems Command (NAVSEA) follows a systematic methodology to develop its own estimates of inflation for budgeting its ship programs. NAVSEA developed this methodology in response to a 2004 direction from the Under Secretary of the Navy for Acquisition.

NAVSEA has developed a complex and detailed model for making these estimates based on current and historical data on labor and material inputs. Labor prices reflect shipyard-specific labor and overhead rates based on shipbuilder forward pricing rate agreements (FPRA).<sup>8</sup> Material prices include class-specific material inflation and vendor base adjustments unique to each ship type's market sector (nuclear, non-nuclear, commercial, etc.). Estimates of future prices are based on forecasts by Global Insight, a private firm that has been involved in economic and financial analysis and forecasting for many years. Historical indexes for labor cost increases are based on actual shipyard data, aggregated to the national level based on the workload at each shipyard. Historical material indexes are based on BLS producer price indexes.

NAVSEA's projections of shipbuilding cost increases are higher than the procurement cost forecasts issued by OUSD(C). NAVSEA estimated annual shipbuilding inflation at 3.3% during 2010–2015, while the OUSD(C) procurement index (the GDP deflator) increased at an average annual rate of only 1.5%.

**NAVAIR Pricing Models.** The Naval Air Systems Command (NAVAIR) develops its own projections for pricing naval aircraft (fixed- and rotary-wing). In a similar fashion to the NAVSEA model, NAVAIR develops estimates for labor and material cost increases and uses these to develop estimates for airframe, engine, and electronics, which are then combined into an overall estimate for fixed-wing aircraft flyway cost.

The variance in these year-to-year projections is surprising. Note, for example, that aircraft inflation is forecast to be halved from 2015 to 2016.

NAVAIR also makes detailed projections for helicopters and missiles. Future labor rates are based on projections for the labor contracts of the major aircraft and missile manufacturers, and materials prices are derived from estimates by Global Insight.

**Marine Corps.** Marine Corps policy is to use the prescribed OUSD(C) inflation factors for program budget and cost estimates. No exceptions have been identified.

### **Air Force**

Air Force policy for inflation adjustments is decentralized, unlike that of the Army and Navy. Program offices may develop their own inflation projections using industry-specific

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<sup>7</sup> Discussion with personnel in the Army Cost Analysis Agency.

<sup>8</sup> An FPRA is a written agreement negotiated between a contractor and the government to use certain rates during a specified period for pricing future contracts or modifications.



prices. These estimates, however, are subject to review by program executive officers, Service acquisition executives, the Air Force Cost Analysis Agency (AFCAA), and the pertinent OSD offices. The description below is based on personal communication from the staff of AFCAA and other organizations.

**Air Force Aircraft.** Most Air Force aircraft program offices estimate future program costs using specific inflation rates obtained by combining labor and material price rates, commercial forecasting model estimates, and contract information on FPRAs. The methods they use appear similar to those adopted by NAVAIR.

**Space Systems.** Most programs use specific rates developed from historical data on inflation in space systems and comparisons with general inflation.

**Information Technology.** Most programs appear to use OUSD(C)-promulgated rates.

#### **National Reconnaissance Office**

The National Reconnaissance Office (NRO) purchases optical- and radar-imaging satellites for reconnaissance and surveillance missions. The NRO in 2004 compared its contractors' labor and material prices with the standard inflation guidance for 1995–2001. Labor prices increased by 4.2% per year on average, but material prices showed no upward trend. Combining the labor and material prices with the appropriate weights yielded an average annual inflation rate of 3%. The OUSD(C) procurement deflator increased by 1.4% annually during the same period (Odom, 2004). The NRO bases its budget and cost estimates in large part on Global Insight direct labor and material price indexes.<sup>9</sup>

#### **Summary**

We have seen that some DoD organizations develop specialized inflation indexes for their programs and use them to ensure that their budget submissions "reflect most likely or expected full costs." These indexes are used both for development of cost estimates for programs in then-year dollars and for budgeting. These rates can be substantially higher than those provided by the OMB.

Real program cost and cost growth for MDAPs are then calculated using the GDP deflator to convert current dollars to constant dollars.

We now turn to a comparison of the OUSD(C) price index—the GDP deflator—with other alternatives developed by BEA and BLS. Our interest here is in seeing whether using price indexes tailored to different defense goods such as aircraft and ships might offer DoD better tools for accounting for inflation.

#### **Analysis of Alternative Deflators for MDAPs**

##### **Introduction**

Note by way of background that all DoD procurement outlays, including MDAPs, account for less than 1% of the GDP. There is no particular reason to believe that DoD procurement prices move in tandem with the other 99% of the economy. Moreover, using a

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<sup>9</sup> We have not comprehensively surveyed the defense agencies or other organizations to establish their policies with respect to projecting inflation. Most such organizations do not have substantial procurement budgets. Those that do have substantial procurement budgets include the Special Operations Command, the Defense Communications Agency, and the National Security Agency, but we do not have information for them.



single price index for all MDAPs ignores the differences among the various military goods that are procured and the markets from which they are bought.

We proceed by first comparing the distribution of DoD purchases with those in the economy as a whole and then comparing DoD inflation for various procurement categories with other inflation indexes of possible interest and with the GDP deflator. After that, we consider the issue of accurately forecasting inflation.

### ***The Distribution of Spending Across Economic Sectors***

Figures from Inforum show that the top 10 sectors that the DoD buys from are, with the exception of wholesale trade, all different from the top 10 sectors for the economy as a whole.<sup>10</sup> The 10 sectors account for roughly half of all purchases in both categories, excluding direct purchases of labor.

Because the DoD and the overall economy purchase very different mixes of items, using the GDP deflator to represent price changes for defense purchases is questionable. Alternative price indexes might provide a better representation.

### ***Retrospective Comparison of GDP With Alternative Price Indexes***

#### ***Bureau for Economic Analysis National Defense Deflators***

In addition to the GDP price deflator, the BEA publishes deflators for procurement of five major types of military systems: aircraft, missiles, ships, vehicles, and electronics. Figure 2 and Table 2 compare these defense deflators to the GDP deflator during the 1985–2009 time period.<sup>11</sup>

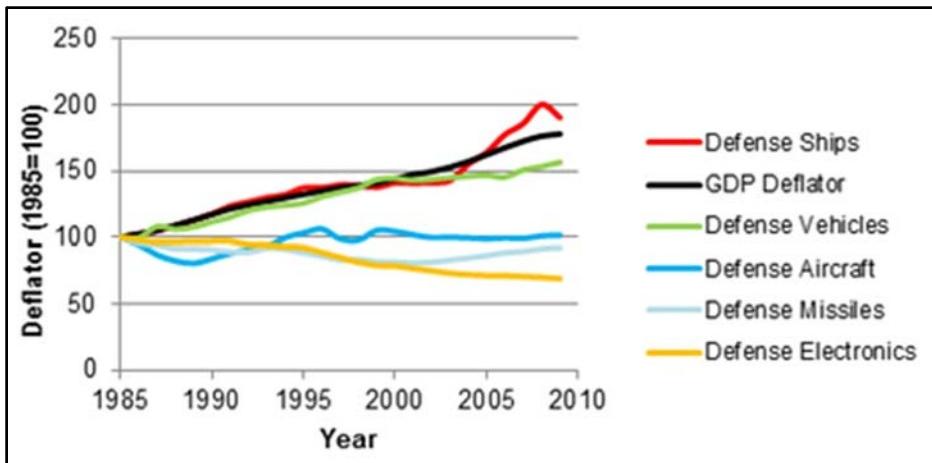
The defense deflators are “quality adjusted” to measure price changes, holding the physical specifications of the systems, or their “quality,” constant. Examples of quality adjustment for aircraft are features, such as engine improvements. The BEA measures the value of quality changes by their cost of production and excludes them from the price index by subtracting the average quality production cost from the average total production cost (Ziemer & Kelly, 1993; Foss, Manser, & Young, 1993). The BEA deflator is thus influenced by changes in average cost due to factors other than improved specifications, such as changes in input prices. According to the BEA, it may be difficult to estimate the quality change when an entirely new kind of aircraft, such as UAVs, is introduced, leading them to consider the entire price as quality change.

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<sup>10</sup> The figures are from 360 sector databases developed by Inforum (The Interindustry Forecasting Project at the University of Maryland). The DoD figures are from the “Federal Defense” table and the economy-wide figures are from the “National” table. (“National” combines spending for federal defense, federal non-defense, non-federal government, and the private sector; Inforum, n.d.).

<sup>11</sup> These BEA deflators are expenditure-weighted averages of separate deflators for durables (largely spares, modifications, overhauls, and support equipment) and gross investment (new equipment). The data are from BEA National Income and Product Accounts Table 3.11.4, Price Indexes for National Defense Consumption and Gross Investment (BEA, 2013).





**Figure 2. GDP vs. BEA National Defense Deflators**

**Table 2. Comparison of BEA National Defense Deflators**

Deflator	Average Annual Growth Rate 1985–2009	Total Growth 1985–2009
Defense Ships	2.7%	90%
GDP	2.4%	78%
Defense Vehicles	1.9%	56%
Defense Aircraft	0.1%	1%
Defense Missiles	-0.3%	-8%
Defense Electronics	-1.5%	-31%

The BEA deflators in Figure 2 show wide variation: (a) substantial deflation over the period for electronics (which includes software), (b) virtually no change in the indexes for aircraft and missiles, and (c) substantial inflation for ships and vehicles. The large decline for electronics is due to the fact that computer speed, memory, and storage capacity have been rising faster than price for many years. The table and figure show that all of the BEA national defense deflators except for ships have had measurably less growth than the GDP deflator over the period. The wide variations, however, may be due to how the BEA identifies and measures quality adjustments.

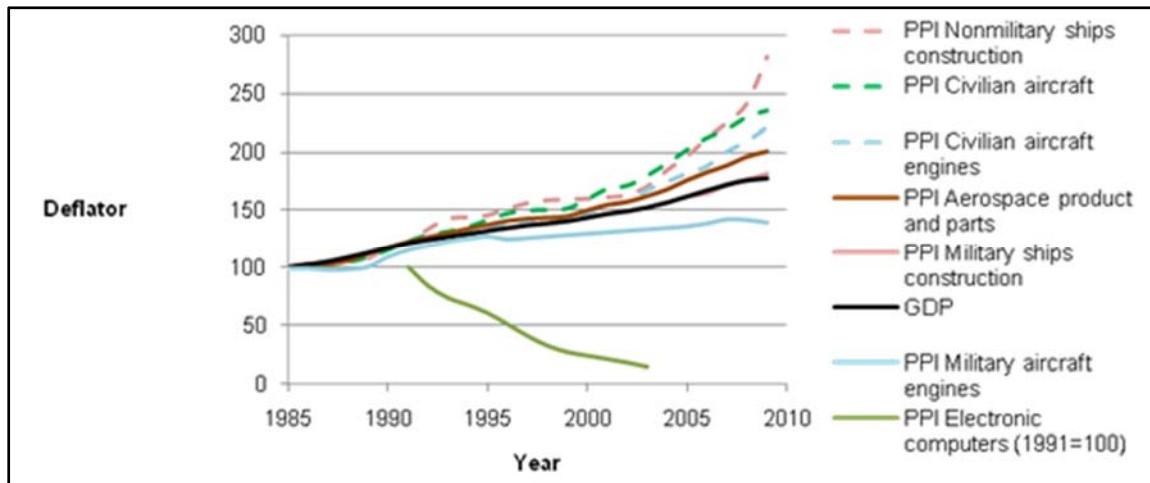
#### **Bureau of Labor Statistics Producer Price Indexes**

Figure 3 and Table 3 compare the GDP price deflator with the producer price indexes (PPIs) that the BLS publishes for military and analogous commercial systems. Like the BEA deflators, BLS price indexes are quality adjusted. The algorithms are described differently but are mathematically equivalent, and they employ the same general criteria (holding specification constant). However, there is no communication between the two organizations on how DoD procurement data are handled.

The bottom four PPIs in Figure 3 (solid lines other than for the GDP deflator) are relevant to defense, and the top three (dashed lines) are for analogous civilian goods included for comparison. The PPIs show substantially smaller growth rates for military aircraft engines and ships than for the analogous civilian goods. The disparity between the GDP and military growth rates is less for the PPIs than for the BEA national defense



deflators shown earlier. Aircraft engines have grown less, ships have grown about the same, and aerospace goods have grown more. (We are regarding the aerospace PPI as reflecting defense goods because BLS includes military communication and reconnaissance satellites as well as civilian-funded NASA space shuttles.) A now-discontinued PPI deflator for electronic computers during the 1991–2003 time period, normalized to 1991 = 100, indicates that computers experienced a huge average annual (quality adjusted) price decrease of 14.8% during this period (Table 3).



**Figure 3. Producer Price Index Defense and Analogous Civilian Deflators**  
(BLS, n.d.)

**Table 3. Comparison of Bureau of Labor Statistics Defense-Related Deflators**

Deflator	Average Annual Growth Rate	Total Growth
PPI Non-military ship construction	4.4%	182%
PPI Civilian aircraft	3.6%	135%
PPI Civilian aircraft engines	3.4%	121%
PPI Aerospace product and parts	2.9%	101%
PPI Military ship construction	2.5%	82%
GDP	2.4%	78%
PPI Military aircraft engines	1.4%	40%
PPI Electronic computers (1991–2003)	-14.8%	-85%

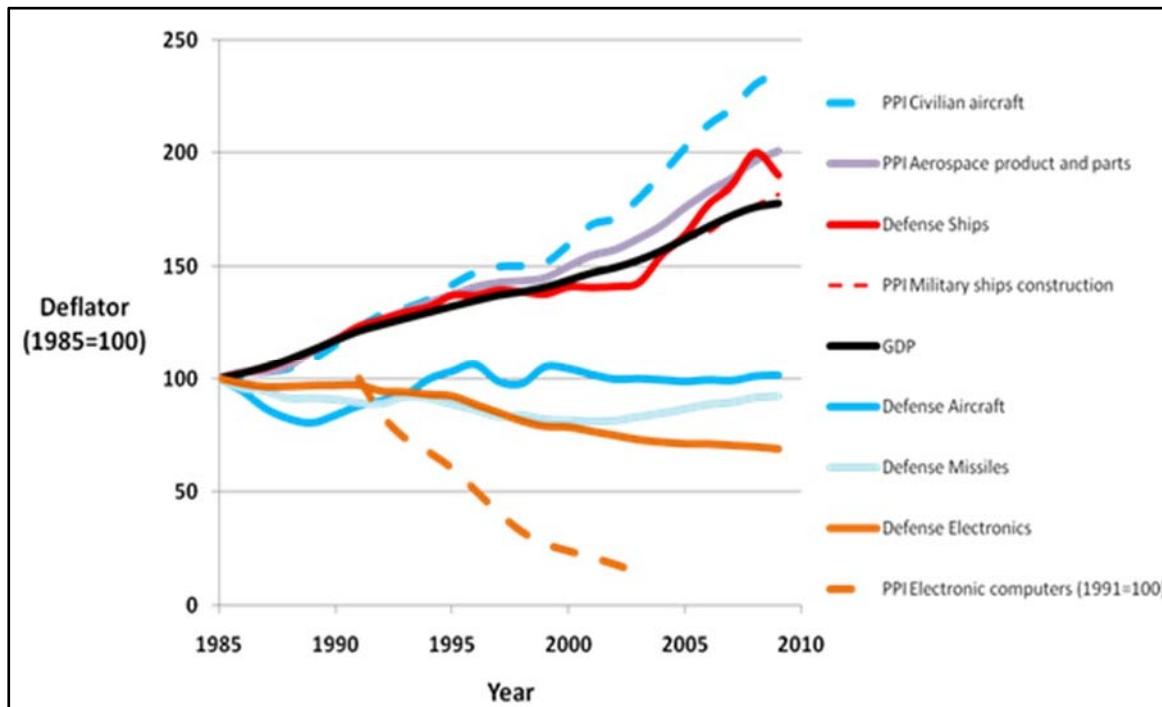
As with the BEA deflators, some of the differences in growth rates might be due to the criteria and numerical methods for making quality adjustments.

#### **Bureau of Economic Analysis and Bureau of Labor Statistics Price Indexes That Are Most Relevant for Defense**

Figure 4 brings together the BEA and BLS PPI series that are most relevant to defense final products. There are major differences. The BEA indexes for defense aircraft, missiles, and electronics have grown much less than the GDP index. The aircraft index is



extremely far below the PPI index for civilian aircraft. The deflators for aerospace and military and ships are quite close to the GDP index.<sup>12</sup>



**Figure 4. Defense and Producer Price Index Deflators Related to Defense**

#### **Conclusions From Retrospective Comparison of Alternative Deflators**

The BEA national defense deflators seem most relevant to MDAPs because of the deflators' focus on defense-related products, but they are not entirely credible. The indexes for aircraft and missiles show much lower rates of increase than the GDP deflator and even much lower rates of increase than is measured for the commercial aircraft sector. As mentioned earlier, this might depend in part on how costs associated with improvements in capability are measured for purposes of making quality adjustments. Other indexes—for example, the national defense deflators for ships and vehicles and the PPI for military ships—have moved similarly to the GDP deflator.

The policy implication of these comparisons is that the difference in growth rates among the defense and defense-related indexes suggests that the DoD might obtain better measures of the real value of the overall MDAP budget by using sector-specific alternative price indexes instead of the GDP deflator. However, given the wide variability we have observed, our analysis fails to provide a clear picture. A better understanding of how the quality adjustments are made is needed.

Perhaps most important, neither the BEA nor the BLS provides price indexes that are derived from the prices of inputs used in the production of various types of MDAPs. The development and use of such indexes by organizations like NAVAIR reflects the indexes' superiority.

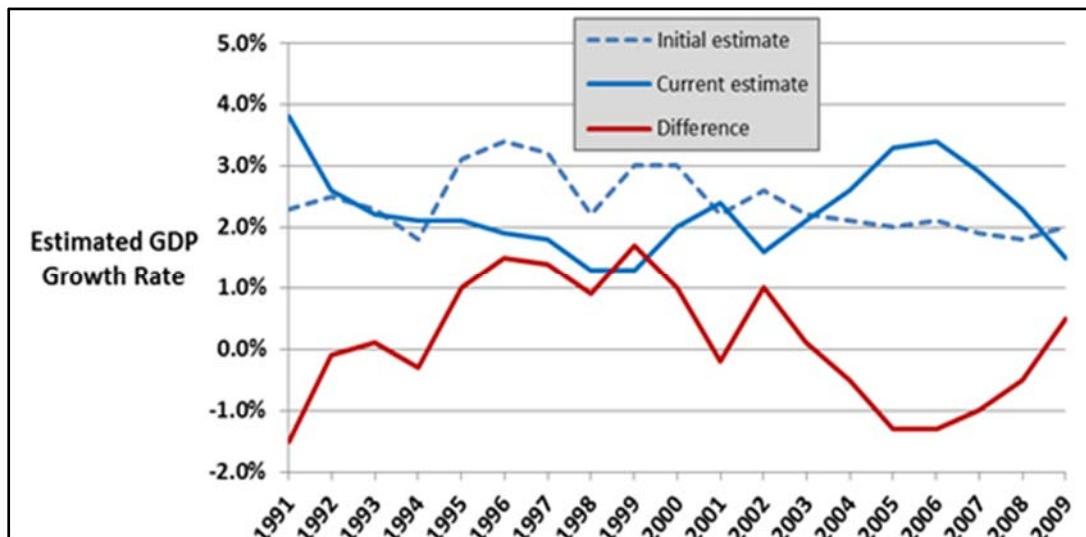
<sup>12</sup> The BLS does not publish indexes for military aircraft because there are not enough domestic producers to meet the BLS's standards for survey respondent confidentiality and statistical accuracy of the index.



### **Prospective Analysis: Success in Forecasting Inflation**

Inflation predictions are useful in budget preparation only to the extent that they are accurate. The OMB forecasts the growth rates of the GDP deflator five years into the future, and Figure 5 shows the accuracy of these forecasts during the past 19 years. The initial forecast for 1991 in 1986, for example, was 2.3%, 1.5% lower than the most recent estimate of 3.8% in 2010.

Overall, the five-year forecasts seem fairly accurate. The number of overestimates and underestimates was about the same (10 vs. 9), and the absolute value of the yearly errors averaged only 0.8%. The overestimates were a bit larger than the underestimates, with maxima of 1.7% and 1.5%, respectively.



**Figure 5. Accuracy of Predictions of the GDP Inflation Rate Five Years in the Future (OUSD[C], 2010)**

The estimates usually became more accurate as the year of execution approached, but they varied a good deal from year to year.

Because organizations like NAVAIR use inflation estimates developed by Global Insight, it would be useful to examine how accurate those estimates have been. Unfortunately, we do not have enough information at present to conduct such an analysis.

### **Assessment of Current Practices for Accounting for Inflation in the DoD**

We previously mentioned that price indexes are used for two separate purposes in the DoD:

- budgeting for future spending, and
- measuring real cost growth in acquisition programs and identifying those programs whose real cost has grown enough to justify special management attention.

A key goal of budget development for particular programs is to allocate sufficient but not excessive funds for specific purposes. Budgeting for personnel, fuel, and health-related expenses draws on specific price indexes tailored for them and should meet the goal.

In the case of MDAPs, as long as programs follow the guidance to "reflect most likely or expected full costs," the goal should be met. However, if Comptroller rates are used to



estimate future price increases, in cases where those increases are expected to be greater or smaller than the Comptroller rates, programs will be underfunded or overfunded.

Program offices may have a tendency to over-estimate future price increases in order to build contingency reserves. The rationale for using specific price indexes should be clearly presented in budget submissions and should be subject to systematic review and approval at both the Service and OSD levels.

Our review of current practices in the section Current Practice for Incorporating Inflation Into Program Budgets and Cost Estimates for Major Defense Acquisition Programs indicates that program- or sector-specific price indexes based on input prices are used in shipbuilding, aviation, and space—areas in which Comptroller rates are often deemed to rise too slowly. The section Analysis of Alternative Deflators for MDAPs indicates that price increases for ground vehicles may have not differed greatly from the GDP deflator. In other words, current practices for procurement budgeting may reflect most likely or expected full costs fairly well overall.

Concerning the use of inflation escalation indexes for calculating real program cost growth, we discuss two possibilities:

- Adjusting for changes in the prices of inputs used for the particular program. This would absolve programs of responsibility for a category of cost increases that are largely beyond their control.
- Adjusting for price changes in the economy as a whole. This implies calculating real cost growth using the GDP deflator.

Use of program-specific indexes would be most consistent with the goal of identifying programs whose costs have risen for reasons other than higher input prices. However, program-specific input price indexes are not always available, and there is some virtue in the simplicity of using a single index to calculate real cost growth.

Using the GDP deflator to calculate real cost growth relative to the baseline can be justified. Real cost growth is consistently measured in terms of the cost of programs to the economy as a whole, not in terms of the physical resources used by the program. The current practice of using the best available information to prepare then-year dollar estimates means that program-specific input price increases that are expected to exceed general inflation are built into the baseline and do not count as cost growth. Unanticipated increases in input prices do contribute to measured cost growth and can contribute to Nunn-McCurdy breaches.

## Concluding Observations and Suggestions

### Observations

- There is no single price or inflation index that should be used for all purposes. The appropriate index depends on the mix of goods and services under consideration. If the context is measuring cost to the economy, a broad-index, like the GDP deflator, is appropriate. If the context is narrower, like predicting the cost of specific kinds of purchases, a more focused index is appropriate.
- The GDP deflator and the price indexes for particular sectors developed by the BEA and BLS are based on output prices. Although the DoD's purchases, including MDAPs, are outputs from the private sector, the cost-based nature of contract development supports the use of input-price-based indexes for MDAPs.



- Current DoD practices regarding the treatment of inflation support the DoD's needs for accurate budgeting and for calculating real program cost growth.
- Although the use of program-specific estimates of future input-price changes is the best way to ensure accurate budgeting for MDAPs, the estimates require systematic review at both the Service and OSD levels to resist a possible tendency to accumulate budget reserves in the guise of preparing for inflation.
- Guidance by the OUSD(C) on the use of its indexes to determine budgetary requirements and develop program cost estimates currently calls for budgets that (a) reflect most likely or full costs, and (b) use OUSD(C) indexes to determine price escalation. The guidance further states that the Comptroller's price indexes should be used to "determine the amount of price escalation for a procurement line item, major RDT&E system, or construction item over a given time period" (DoD, n.d.). This guidance is being revised to make it clear that most likely or expected full costs in then-year dollars should be used in budget preparation—even if this implies price increases different from those implied by Comptroller's indexes—and that Comptroller indexes must be used to convert then-year dollar values to constant-dollar values.
- The use of the GDP deflator to measure price increases for all DoD procurement programs is conceptually inappropriate. Healthcare, fuel and personnel have price indexes specific to them. This is not true for procurement. Empirically, the GDP deflator may be a reasonable proxy for procurement inflation overall, though this cannot be demonstrated. But it does not allow the DoD to capture differences between, for example, ships, aircraft, and vehicles. Individual organizations often develop their own approaches.
- This initial study does not indicate what alternative system- or category-specific indexes would provide better estimates of inflation for procuring the various types of systems. Government statistical organizations do not publish price indexes based on the prices of inputs to the production of systems, but they presumably could.
- Current practice does not appear consistent with either of the notions of constant prices noted at the start of the paper. By using tailored indexes for civilian personnel, military personnel, fuel, and medical care, it does not consistently calculate constant dollar costs in terms of resources foregone by the economy as a whole. By using the GDP deflator for procurement, it does not consistently calculate constant dollar costs in terms of the value of the resources acquired to the DoD.
- Some procurement price indexes, particularly the BEA national defense indexes for aviation and missiles, appear surprisingly low, with negligible growth since 1985. This may be due, at least in part, to the way that quality adjustments are identified and estimated.
- There has been little systematic tendency to either overestimate or underestimate inflation. Prediction of inflation five years in the future has been wrong by only about 0.8% on average.



## **Suggestions**

- Complete the planned revision of OUSD(C) guidance.
- Investigate the feasibility of developing procurement price indexes tailored to different kinds of equipment. This would involve deeper analysis of the BEA and BLS for military systems, especially the use of indexes based on the prices of inputs to military systems.
- Compare the accuracy of inflation predictions promulgated by OMB and those developed by Global Insight.

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